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(54) Title: HEAT SEALABLE MULTILAYER FILM CONTAINING POLYVINYL ALCOHOL LAYER

(57) Abstract

A multilayer heat sealable film comprises: (a) a polyolefin film substrate layer; (b) a heat sealable acrylic polymeric coating; and (c) a layer of poly(vinyl alcohol) (PVOH) between (a) and (b). The film exhibits excellent oxygen and aroma barrier, and low minimum seal temperature and can be prepared by i) providing an oriented polypropylene film core layer; ii) coating said oriented polypropylene film core layer with PVOH on at least one side of said core layer to provide a PVOH coated oriented polypropylene film; and iii) coating the product of ii) with acrylic on said side coated with PVOH.

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"HEAT SEALABLE MULTILAYER FILM CONTAINING POLYVINYL ALCOHOL LAYER".

This invention relates to a multi-layer film structure comprising an oriented polypropylene core layer, a poly(vinyl alcohol) (PVOH) layer, and an acrylic coating.

Oriented plastic film, specifically biaxially oriented polypropylene film is widely used for packaging products, particularly foods. No single unmodified polymeric film, however, has the gas and moisture barrier characteristics needed for packaging.

Thus, multilayer polymeric films have been designed which have improved gas and moisture barrier properties. In U.S. Patent No. 5,192,620 to Chu et al. a polypropylene film is coated with a blend of an ethylene-acrylic acid copolymer and poly(vinyl alcohol) (PVOH) to produce a polymeric film having better gas barrier properties. The film is then metallized to provide the film with better moisture barrier properties.

Since PVOH, on its own, adheres poorly to the preferred substrates, such as polypropylene, U.S. Patent No. 5,153,074 to Migliorini suggests functionalizing the substrate with a maleic anhydride modified propylene homopolymer to act as a tie layer for the PVOH, see col. 1, lines 49-62. For purposes of making a metallized film, however, the Migliorini patent is only concerned with ethylene vinyl alcohol copolymer (EVOH) which is not as good an oxygen barrier as PVOH.

A polymeric film having a PVOH skin layer is described in European Patent Application 461,772 A2. The moisture barrier properties of the PVOH layer are improved by employing crosslinked PVOH. There is no suggestion to metallize the film because the crosslinking agent makes metal adhesion unreliable; that is, it can vary from 0 to 70%.

The PVOH skins described in European Patent Application No. 461,772 And U.S. Patent No. 5,192,620 are applied through a solution coating process. Pure PVOH

applied by solution coating has a tendency to pose blocking problems when wound onto a roll. European patent application 461,772 sought to remedy this problem by incorporating a crosslinking agent in the PVOH solution.

Acrylic copolymers have been used as heat sealable coatings for oriented thermoplastic films such as polypropylene film. When thermoplastic film substrates are coated with these heat sealable coatings, it is particularly important to insure that the adhesion of the coating layer to the film substrate is adequate. In many packaging operations it is necessary for the coated film to be heat sealed to itself or to other films to form tightly closed packaging. If the coating adhesion to the base film is inadequate, the packages may prematurely open when subjected to stress.

In general, acrylic coatings do not adhere well to certain polyolefin film surfaces, e.g., polypropylene, even when the latter have been subjected to well known pre-treatment operations such as treatment by corona discharge, flame, or oxidizing chemicals. Accordingly, it has often been found necessary to apply a thin intermediate primer layer to the surface of the polyolefin base film before applying heat sealable topcoats. Moreover, the acrylic coatings themselves are not especially effective as oxygen and aroma barriers.

It would be advantageous to provide an acrylic coated polypropylene film which enjoys not only enhanced sealing characteristics but enhanced oxygen barrier as well. Moreover, it is desirable to provide a method for reducing the minimum seal temperature of a heat sealable film in order to permit heat sealing at lower temperatures thereby providing a wider operating range for sealing machinery.

The present invention relates to a multilayer heat sealable film comprising:

(a) an oriented polypropylene film substrate layer;

(b) a heat sealable acrylic polymeric coating, and

(c) a layer of a poly(vinyl alcohol) (PVOH) between (a) and (b).

The resulting film exhibits excellent oxygen barrier, as well as enhanced sealability evidenced by reduced minimum seal temperature compared to such or similar films lacking the PVOH component. Such minimum seal temperatures can be no greater than 99°C, preferably, no greater than 96°C. For present purposes, the minimum seal temperature is the temperature required to achieve a 100 gm/in seal. The present invention is particularly suited to providing films having an ultimate seal strength (USS) which is the highest seal strength attainable under practical heat sealing conditions. For the purpose of comparison, a sealing temperature of 270°F is used. The present invention can be used to obtain films having a USS of greater than 200 g/in, preferably greater than 300 g/in, or even greater than 400 g/in.

Preferably, the film further comprises a suitable primer between the polypropylene film substrate layer and said poly(vinyl alcohol) layer. The film may further comprise a suitable primer between the poly(vinyl alcohol) layer and the heat sealable acrylic polymeric coating.

In another aspect, the present invention relates to a method for preparing an acrylic coated multilayer film which comprises

i) providing an oriented polypropylene film core layer;

ii) coating said oriented polypropylene film core layer with PVOH on at least one side of said core layer to provide a PVOH coated oriented polypropylene film; and

iii) coating the product of ii) with acrylic on said side coated with PVOH.

The method can further comprise applying a suitable primer to said polypropylene film core layer prior to step

ii) and applying a suitable primer to said PVOH coating prior to step iii).

The polypropylene film substrate layer used in the present invention can comprise homopolymer polypropylene or ethylene propylene copolymer containing predominantly propylene. A preferred embodiment of said polypropylene film substrate comprises a layer of homopolymer polypropylene and a layer of the copolymer. In oriented films of the present invention, the melt flow rate of the polyolefin layer must not be so low that it is too stiff and thus unorientable. For propylene ethylene copolymers, it is preferred that the melt flow rate be from 2.5 to 6.0 grams per 10 minutes at 230°C and a load of 2,160 grams. For polypropylene, it is preferred that the melt flow rate be from 2.5 to 4.5. In this range, orientation of the copolymer or the polypropylene results in the best properties.

The extruded polypropylene film can be biaxially oriented. Biaxially oriented film can be stretched 3.5 to 7.0 times, preferably 4 to 6 times, in the machine direction (MD), and 5 to 15 times, preferably 6 to 12 times, in the transverse direction (TD). The overall orientation (MD X TD) can range from about 25 to 60. After orientation, the edges of the film can be trimmed and the film wound onto a core.

PVOH is of a suitable grade which can be applied to the oriented polypropylene film substrate through a solution coating process, as described in European Patent Application No. 461,772 or U.S. Pat. No. 5,192,620, incorporated herein by reference. Poly(vinyl alcohol) is typically produced by hydrolyzing poly(vinyl acetate). Specifically, the hydrolysis reaction replaces the acetate groups with alcohol groups. The more acetate groups that are replaced, the greater the hydrolysis of the PVOH. It

is believed that the presence of more alcohol groups (i.e., greater hydrolysis) provides better barrier properties.

However, even after hydrolysis of the PVOH, a certain number of acetate groups remain attached to the PVOH molecule. For example, in a 95% hydrolyzed PVOH approximately 5% of the originally present acetate groups remain attached to the molecule, whereas in a 99% hydrolyzed PVOH approximately 1% of the originally present acetate groups remain attached to the molecule.

Poly(vinyl alcohol) may be produced with various viscosities and various degrees of hydrolysis. Viscosity is typically a function of the molecular weight of the PVOH molecule. Specifically, a solution of PVOH in which the individual molecules are relatively large (i.e., a high molecular weight PVOH) tends to have a higher viscosity than a solution of PVOH in which the individual molecules are relatively small (i.e., a low molecular weight PVOH). It is believed Van der Waals forces develop between the larger-sized molecules because such molecules tend to align themselves with one another, thus increasing the viscosity of the PVOH.

A poly(vinyl alcohol) such as Elvanol 71-30 (produced by DuPont) is typically referred to as a medium viscosity, fully hydrolyzed PVOH. Specifically, the degree of hydrolysis of a fully hydrolyzed PVOH is about 98%. Further, the viscosity of a medium viscosity grade PVOH such as Elvanol 71-30 is about 30 cps at 4% solution and 20°C.

Another commercially available PVOH is Elvanol 75-15 (also produced by DuPont), which is a low viscosity, fully hydrolyzed PVOH. Specifically, the degree of hydrolysis is about 98% and the viscosity is about 13 cps at 4% solution and 20°C.

Still another commonly available PVOH is Elvanol 90-50 (also produced by DuPont), which is a low viscosity super

hydrolyzed PVOH. The degree of hydrolysis in a super hydrolyzed PVOH is about 99.5%. The viscosity of a low viscosity grade PVOH such as Elvanol 90-50 is about 13 cps at 4% solution and 20°C. Another commercial source of extrudable PVOH is Vinex resin manufactured by Air Products and Chemicals, Inc.

Commercially suitable coating processes include a reverse direct gravure process and a smooth rod process. As is known to those skilled in the art, the gravure process typically produces a higher level of foam than the smooth rod process. The tensoactive agent reduces the degree of foaming, while simultaneously lowering the surface energy of the coating solution. The combination of reduced foaming and lower surface energy provides improved processing characteristics which result in a barrier exhibiting reduced transmission of oxygen, particularly at high relative humidities.

With respect to the gravure process, the coating solution of the present invention preferably includes approximately 200 to 500 ppm of 1-octanol and, more preferably, about 250 ppm of 1-octanol. With respect to the smooth rod process, the coating solution preferably includes from 5 to 50 ppm of 1-octanol. This lower level of tensoactive agent provides improved processing characteristics and reduces the likelihood that the subsequently-formed oxygen barrier will suffer any negative impacts from the inclusion of such agent in the solution.

The solution, which is preferably aqueous, is prepared by adding the poly(vinyl alcohol) to cold water, which is thereafter heated to a temperature sufficient to dissolve the PVOH. The water and dissolved PVOH are then cooled. The cross-linking agent (i.e., the glyoxal) is then added to the cooled PVOH and water. Thereafter, an effective amount of the tensoactive agent is added to the solution.

It is this resultant solution that is then coated on the polymeric substrate.

In a preferred embodiment, the aqueous solution includes from 4% to 14% by weight of solid and, preferably, from 5% to 10% by weight of solid. This solid content is made up from 70% to 95% by weight of poly(vinyl alcohol), from 5% to 30% by weight of cross-linking agent and from 5 ppm to 0.5% by weight of octanol.

The enhanced stability of this aqueous solution, with the use of low viscosity PVOH, allows for higher solids content of the solution, thereby reducing the percentage of water in the solution. Accordingly, the applied solution is more readily dried. This reduced drying time results in an energy savings and/or a speed increase from the coating machinery. It is also believed to facilitate the cross-linking process as well as providing a longer pot life for the solution.

Particularly, once the coating is applied to the substrate, the film is rolled through a drying oven. A typical drying oven is approximately 60 feet long and adapted to heat the film to approximately 130°C. The film is rolled through the oven at speeds of about 1000 feet per minute. As the film rolls through the oven, the water in the applied coating is driven off which, in turn, increases the concentration of the solid content. At some point (i.e., at a particular concentration and temperature), the cross-linking process is initiated. This cross-linking process occurs rapidly and completely throughout the PVOH layer such that the film is substantially 100% cross-linked by the time such film leaves the drying oven.

A PVOH coating ranging from about 0.02 to 0.06 mil, preferably, 0.010 to 0.040 mil, can be applied.

The heat sealable acrylic polymeric coating can, for example, be derived from any of the terpolymeric compositions disclosed in U.S. Pat. No. 3,753,769, the

contents of which are incorporated herein by reference. These coating compositions contain as a film forming component a resin consisting essentially of an interpolymer of (a) from 2 to 15, and preferably from 2.5 to 6, parts by weight of an alpha-beta monoethylenically unsaturated carboxylic acid selected from the group consisting of acrylic acid, methacrylic acid, and mixtures thereof, and (b) from 85 to 98, and preferably from 94 to 97.5, parts by weight of neutral monomer esters, said neutral monomer esters preferably comprising (1) methyl acrylate or ethyl acrylate and (2) methyl methacrylate. These interpolymer compositions are further characterized as preferably comprising from 30 to 55 percent by weight of methyl methacrylate when said alkyl acrylate is methyl acrylate, and from 52.5 percent to 69 percent by weight of methylmethacrylate when said alkyl acrylate is ethyl acrylate. Such coating compositions can be applied to the films herein in a variety of ways including in the form of ammoniacal solutions.

Similarly useful are copolymeric coating compositions prepared exclusively from the foregoing neutral monomer esters. These coating compositions are advantageously applied to the film laminates in the form of emulsions.

An adhesive tie layer can be used to enhance adhesion between the PVOH layer and the polypropylene film substrate layer when such layers are incompatible in their natural state. The adhesive layer when used can be any of a number of proprietary materials such as described in U.S. Pat. No. 4,561,920. Suitable adhesives include CXA-3036 (TM) (an ethylene-vinyl acetate copolymer available from DuPont), a high density polyethylene based adhesive, e.g., Bynel 4003 (TM) available from DuPont, the Admer (TM) adhesives from the Mitsui Petrochemical Company, e.g., NF500A (TM) and NF 550A (TM), and the Plexar (TM) family from USI Chemicals, e.g., a maleic anhydride grafted LDPE, Quantum Plexar 201

(TM). Suitable maleic anhydride modified polyolefins include maleic anhydride modified polypropylene homopolymer or copolymer which are especially suitable for use as adhesive tie layer in the present invention. Such materials result from the reaction between maleic anhydride and the thermal degradation product of polypropylene or polypropylene copolymer. Examples of this material are disclosed in U.S. Pat. No. 3,480,580, the contents of which are incorporated herein by reference in its entirety. Particular attention is directed to Examples 3, 4, and 6 of this patent. A commercially available maleic anhydride modified polypropylene is Epolene E-43(TM), from Eastman Kodak Company of Rochester, NY.

The adhesive tie layer can be dispensed with by including an adhesion promoter in the polyolefin layers as described in U.S. Pat. No. 4,650,721, which is incorporated herein by reference. That patent discloses polyolefin layers (polypropylene) which contain a maleic anhydride modified olefin polymer.

PVOH coating is preferably applied over an appropriate primer interface to assure adequate bonding to the base substrate. A second bonding primer layer can also be applied onto the PVOH layer to provide adequate bonding for the acrylic layer. Typical primers for such purpose include an aqueous polyethyleneimine solution. Polyethyleneimine primer is commercially available and is generally applied as a 0.1%-0.6% by weight polyethyleneimine solution in water or organic solvent. The use of PEI as a primer or adhesive for polymeric coatings to films substrates is well known to the art, as disclosed in U.S. Pat. No. 3,230,135, incorporated herein by reference.

Epoxy polymers and polyurethanes are also useful as primers. Such primer compositions are disclosed in U.S.

Pat. Nos. 4,447,494, 4,681,803, and 3,023,125, which patents are incorporated herein by reference.

The PVOH layer, preferably after priming, is coated with the acrylic polymeric coating by conventional techniques as noted above. Such coating can be carried out either before or after, preferably after, the PVOH layer is combined with the polyolefin core layer.

In one embodiment, the present invention relates to a method of making a biaxially oriented composite barrier film having two or more layers which can be conducted in a continuous manner.

First, a polypropylene sheet is formed by extrusion. As the sheet exits the die, it is immediately cooled by use of a cooling drum or a water bath to a temperature of about 40 to 50°C. Immediately after cooling, the sheet can be fed into an apparatus for MD orientation of the plastic material. Any such apparatus can be used in the present invention. In one embodiment, the composite sheet is fed into a set of differential speed heated rollers to stretch the sheet in the longitudinal direction to a degree ranging from greater than 1:1 and less than 2:1, preferably about 1.2:1 to 1.5:1, say, e.g., 1.3:1. Next, the sheet can be fed to a tenter frame where it is stretched in the transverse direction to a degree of greater than 5:1, preferably from 5:1 to 12:1, e.g., 8:1 to 9:1. MD orientation is generally conducted by preheating the film at 130°C to 145°C, stretching in the same temperature range, and annealing at about 115°C to 125°C. Preheating for TD orientation is advantageously done at 160°C to 175°C, stretching at 145°C to 160°C, and annealing at 155°C to 165°C.

The oriented polypropylene sheet is thereafter primed with a suitable epoxy or PEI primer and then solution coated with PVOH barrier layer to provide a PVOH layer of 0.015 to 0.035 mil. The PVOH coating of the sheet is

thereafter primed to provide suitable bonding between PVOH and acrylic heat seal layer which is thereafter applied by the above-described process.

Finally, the sheet, either before or after coating with acrylic, can optionally be subjected to treatment in the known manner, e.g., corona discharge treatment or flame treatment, to improve its surface characteristics, e.g., printability.

The multilayer heat sealable film of the invention can have an overall thickness ranging from 0.50 to 2.0 mil.

The films of this invention are suitable in a variety of applications in which moisture and gas barrier properties are desired. The films are particularly useful in food packaging.

The invention is illustrated by the following non-limiting examples in which all parts are by weight unless otherwise specified.

EXAMPLE 1--OPP/PEI/PVOH (Comparative)

Sample 1 was produced. A solution of Elvanol 71-30, Parez 613 (a methylated melamine formaldehyde) and ammonium chloride was coated onto a polymeric substrate of biaxially oriented polypropylene approximately .75 mils thick. The solution contained 6% by weight of solid. In turn, the solid contained approximately 83% by weight of PVOH, approximately 15% by weight of methylated melamine formaldehyde and approximately 2% by weight of ammonium chloride.

The substrate was treated with a poly(ethyleneimine) primer prior to application of the coating. The coating was applied to the polypropylene substrate using a smooth rod process. The coated substrate was rolled through a dying oven about 60 feet in length at about 800 feet per minute, heating the film to 130°C and initiating cross-linking. The film was then measured for oxygen

transmission at 0% relative humidity, minimum seal temperature, and ultimate seal strength. As can be seen from the results set out in the Table below, seal properties were unacceptable.

EXAMPLE 2--OPP/PEI/ACRYLIC (Comparative)

A polymeric substrate of biaxially oriented polypropylene 0.75 mils thick was coated with an acrylic coating solution prepared in accordance with Example 1 of U.S. Pat. No. 3,753,769, which is incorporated herein by reference in its entirety.

The substrate was treated with a poly(ethyleneimine) primer prior to application and drying of the coating. The film was then measured for oxygen transmission at 0% relative humidity, minimum seal temperature, and ultimate seal strength. As can be seen from the results set out in the Table below, oxygen transmission properties were unacceptable.

EXAMPLE 3-OPP/PEI/PVOH/EPOXY/LOW TEMPERATURE SEAL COATING (100% CROSS-LINKED PVOH)

Sample 3 was produced. A solution of Elvanol 90-50, Glyoxal 40, available from Freedom Textile, Charlotte, NC and 1-octanol was coated onto a poly(ethyleneimine) primed polypropylene substrate by a reverse direct gravure process. The solution contained 8% by weight of solid. In turn, the solid contained approximately 85% by weight of PVOH, approximately 15% by weight of cross-linking agent and 250 ppm of 1-octanol. The resulting material was primed with an epoxy primer and coated with a low temperature seal coating (LTSC) produced as follows:

Low temperature seal coating composition was prepared by adding to an aqueous solution or fine dispersion of 25 wt.% of an ammonium salt of a copolymer of 80 wt.% of ethylene and 20 wt.% of acrylic acid, sold by Michelman as

Primacor 4983, varying amounts of sodium hydroxide (NaOH), poly(oxymethylene) sorbitan monooleate anti-static agent (A-S), sold as Glycosperse O-20, microcrystalline wax having an average size of about 0.12 to 0.2 micron (MWX) sold by Michelman as 41540, and melamine-formaldehyde cross-linking agent (M-F) sold as Cymel 385. In addition, 0.4 phr of talc and 0.1 phr of fumed silica having an average particle size of about 3 to 5 microns sold as Syloid 72 were also added to each composition. All the components were added as an aqueous dispersion or solution except the anti-static agent which was added as a pure liquid. Water was then added to bring the final coating composition to a solids content (% SOL) of 12 wt%.

The characteristics of the film were thereafter measured and the results are set out in the Table below.

EXAMPLE 4-OPP/PEI/PVOH/EPOXY/ACRYLIC (100% CROSS-LINKED PVOH)

Sample 4 was produced by the procedure set out in Example 3 except that the low temperature seal coating was substituted by the acrylic coating of Example 2. The characteristics of the film were thereafter measured and the results are set out in the Table below.

EXAMPLE 5-OPP/PEI/PVOH/LTSC (10% CROSS-LINKED PVOH)

Sample 5 was produced. A solution of Elvanol 71-30, Parez 613 (a methylated melamine formaldehyde) and ammonium chloride was coated onto a polymeric substrate of biaxially oriented polypropylene approximately .75 mils thick. The solution contained 6% by weight of solid. In turn, the solid contained approximately 83% by weight of PVOH, approximately 15% by weight of methylated melamine formaldehyde and approximately 2% by weight of ammonium chloride.

The substrate was treated with a poly(ethyleneimine) primer prior to application of the coating. The coating was applied to the polypropylene substrate using a smooth rod coating process. The low temperature seal coating set out in Example 3 was applied to the PVOH layer. The resulting product contained 10% cross-linked PVOH. The characteristics of the film were thereafter measured and the results are set out in the Table below.

EXAMPLE 6-OPP/PEI/PVOH/ACRYLIC (10% CROSS-LINKED PVOH)

Sample 6 was produced by the procedure set out in Example 5 except that the low temperature seal coating was substituted by the acrylic coating of Example 2. The characteristics of the film were thereafter measured and the results are set out in the Table below.

EXAMPLE 7-OPP/PEI/PVOH/EPOXY/ACRYLIC (10% CROSS-LINKED PVOH)

Sample 7 was produced by the procedure set out in Example 6 except that the PVOH coating was primed with an epoxy primer prior to coating with the acrylic coating.The characteristics of the film were thereafter measured and the results are set out in the Table below.

EXAMPLE 8-OPP/PEI/PVOH/PEI/ACRYLIC (10% CROSS-LINKED PVOH)

Sample 8 was produced by the procedure set out in Example 6 except that the PVOH coating was primed with a polyethyleneimine (PEI) primer prior to coating with the acrylic coating. The characteristics of the film were thereafter measured and the results are set out in the Table below.

TABLE

	TO2	MST	ULTIMATE SEALS (g/in)
OPP/PEI/PVOH	* <0.05	NIL	NIL
OPP/PEI /ACRYLIC	* 150.	96°C	600
OPP/PEI/PVOH/ EPOXY/LTSC (100% cross-linked PVOH)	* 0.017	97°C	650
OPP/PEI/PVOH/ EPOXY/ACRYLIC	* 0.010	97°C	405
OPP/PEI/PVOH/LTSC (10% cross-linked PVOH)	* 0.175	99°C	212
OPP/PEI/PVOH/ACRYLIC (10% cross-linked PVOH)	* 0.062	96°C	418
OPP/PEI/PVOH/EPOXY ACRYLIC (10% cross-linked PVOH)	* 0.079	98°C	218
OPP/PEI/PVOH/ PEI/ACRYLIC (10% cross-linked PVOH)	* 0.099	96°C	387

* All results in C.C./100 sq. in./24 hour, 0% rel. humidity

It is apparent from the data set forth in the Table that films having the combination of the PVOH and acrylic coatings, including low temperature seal coatings, produced in accordance with the present invention are superior to those of the prior art.

CLAIMS:

1. A multilayer heat sealable film comprising:
(a) an oriented polypropylene film substrate layer;
(b) a heat sealable acrylic polymeric coating; and
(c) a layer of poly(vinyl alcohol) (PVOH) between (a) and (b).

2. The multilayer heat sealable film of claim 1 which further comprises:
(d) a primer layer between (a) said polypropylene film substrate layer and (c) said layer of poly(vinyl alcohol) (PVOH).

3. The multilayer heat sealable film of claim 2 which further comprises:
(e) a primer layer between (c) said layer of poly(vinyl alcohol) (PVOH) and (b) said heat sealable acrylic polymeric coating.

4. The multilayer heat sealable film of claim 3 wherein:
said polypropylene film substrate comprises homopolymer polypropylene.

5. The multilayer heat sealable film of claim 4 wherein said polypropylene film substrate further comprises a copolymer layer.

6. The multilayer heat sealable film of claim 4 wherein:

said heat sealable acrylic polymeric coating comprises a resin consisting essentially of an interpolymer of (a) from 2 to 15 parts by weight of an alpha-beta monoethylenically unsaturated carboxylic acid selected from the group consisting of acrylic acid, methacrylic acid, and mixtures thereof, and (b) from 85 to 98 parts by weight of neutral monomer esters.

7. The multilayer heat sealable film of claim 6 wherein:

said primer is selected from the group consisting of polyethyleneimine (PEI), polyurethane, and epoxy.

8. The multilayer heat sealable film of claim 7 wherein said film has been biaxially oriented from 4 to 6 times in the machine direction and from 6 to 12 times in the transverse direction.

9. The multilayer heat sealable film of claim 1 wherein said layer of PVOH ranges from .010 to .040 mil thickness, said multilayer film ranges from 0.5 to 2.0 mil in overall thickness, and has a minimum seal temperature of no greater than 96°C.

10. The multilayer heat sealable film of claim 1 wherein said multilayer film has an ultimate seal strength of greater than 200 g/in.

11. The multilayer heat sealable film of claim 1 wherein said multilayer film has an ultimate seal strength of greater than 400 g/in.

12. A method for preparing a multilayer heat sealable film which comprises

a) providing an oriented polypropylene film core layer;

b) coating said oriented polypropylene film core layer with PVOH on at least one side of said core layer to provide a PVOH coated oriented polypropylene film; and c) coating the product of b) with acrylic on said side coated with PVOH.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US95/15659

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :B32B 7/12, 27/08, 27/30, 27/32, 27/38, 27/40; C08F 20/06, 20/18, 220/06, 220/18
US CL :428/36.6, 36.7, 347, 349, 353, 354, 413, 424.8, 516, 523, 910; 526/318.4
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 428/36.6, 36.7, 347, 349, 353, 354, 413, 424.8, 516, 523, 910; 526/318.4

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS: polypropylene, oriented, polyvinyl alcohol, PVOH, barrier, primer, heat seal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 3,753,769 (STEINER) 21 August 1973, see column 2, lines 8-26; column 4, lines 45-50; column 5, lines 3-30; Tables I, III.	1-7, 9, 12
Y	US, A, 4,927,689 (MARKIEWICZ) 22 May 1990, see column 5, lines 32-50; column 6; column 7, line 60 to column 8, line 4.	1-5, 7, 9
Y	US, A, 5,330,831 (KNOERZER ET AL) 19 July 1994, see column 1, lines 52-66; column 2, line 53 to column 3, line 68; column 4, lines 35-50; Example.	1-5, 7-9, 12
Y	US, A, 5,192,620 (CHU ET AL) 09 March 1993, see column 2, lines 6-27; Example 1.	1, 4-5, 8-9, 12

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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Date of the actual completion of the international search	Date of mailing of the international search report
02 FEBRUARY 1996	28 FEB 1996

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US95/15659

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 5,346,752 (SAWADA ET AL) 13 September 1994, see column 2, lines 36-60; column 3, lines 16-23, 50-59; column 4, line 40.	1-5, 7
Y, P	US, A, 5,407,713 (WILFONG ET AL) 18 April 1995, see columns 10-11; column 14, line 63 to column 15, line 10.	1-5, 12
A	US, A, 4,239,826 (KNOTT, II ET AL) 16 December 1980, see column 1, lines 43-64; column 2, lines 60-61.	1
A	US, A, 4,254,169 (SCHROEDER) 03 March 1981, see column 1, lines 43-63.	1